REMARKS/ARGUMENTS

Applicant appreciates the opportunity afforded by the Examiner for discussing the present application during a telephone interview on April 6, 2004 and the courtesies extended during the interview. During that discussion, Examiner Koch discussed with Mr. Gallo Claims 1-4 and 9 of the present application as well as "Neural Network-Based Control for the Fiber Placement Composite Manufacturing Process" (hereinafter "Lichtenwalner") and U.S. Patent No. 5,886,313 to Krause. In particular, it was agreed that Applicant would submit additional remarks concerning Claim 1. The Examiner also agreed that the rejections of Claims 2, 3, and 9 should be removed, and further indicated that he would reconsider the rejection of Claim 4. Further to that discussion, please consider the following remarks.

In the Office Action dated October 28, 2003, Claims 1-19 are pending, of which Claims 1-11 have been elected for prosecution. Claims 1-4, 6-9, and 11 are rejected under 35 U.S.C. § 103(a) as being unpatentable over "Neural Network-Based Control for the Fiber Placement Composite Manufacturing Process" (hereinafter "Lichtenwalner") and U.S. Patent No. 5,886,313 to Krause. Claims 4, 6, and 7 are also rejected under 35 U.S.C. § 103(a) as being unpatentable over Lichtenwalner and Krause as applied to Claim 1 and further in view of U.S. Patent No. 5,562,788 to Kitson. Claim 10 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Lichtenwalner and Krause as applied to Claim 1 and further in view of U.S. Patent No. 5,066,032 to Albers. Claim 5 is objected to as being dependent on a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim.

Regarding Claim 1, Applicant submits that none of the cited references teaches or describes a composite material collation machine having a laser diode array for heating at least one fiber tape. Further, as discussed below, none of the references provides a motivation for combining the laser diode array of the Krause device with the fiber placement process discussed by Lichtenwalner, and therefore the claimed invention is not made obvious by the cited references.

The Examiner has stated that, in light of a portion of the present application, "[f]or the purposes of examination, the word tape has been interpreted as comprising both tapes and tows (i.e., fibers)." In that portion of the present application, Applicant states that composite tapes and tows are to be "collectively referred to as tape" throughout the application. Indeed, the invention claimed in the present application is directed to a collation machine that can be used for the placement of tapes or tows, and the claims of the present application are directed to both. However, Applicant asserts that despite this convenience of terminology that has been elected for use in the present application, there does exist a difference between such structures as tapes, tows, and fibers as those terms are conventionally used. In particular, the term "fiber" refers to an individual filament of reinforcement material. A "tow" is a bundle formed of a plurality of fibers, which are typically not twisted. For example a 6K tow includes 6,000 fibers, and a 12K tow includes 12,000 fibers. A "tape" typically refers to a collection of collimated fibers, often in the form of tows, configured in a relatively thin strip. A tape also includes a binder, such as a resin, for holding the fibers together.

While the present invention is applicable to collation machines for composite materials using any of tapes, tows, or fibers, the distinction between the different forms of materials is significant in understanding the references cited in the Office Action. In particular, as the title states, Lichtenwalner is directed to "Neural Network-Based Control for the Fiber Placement Composite Manufacturing Process" (emphasis added). Indeed, Lichtenwalner specifically states that "fiber placement is a relatively new process that has evolved from . . . filament winding and tape laying" and that the resulting process "can produce shapes that are too complex for either filament winding or tape laying alone." Although Lichtenwalner does not specifically discuss the reasons why some shapes are too complex to be produced by tape laying, the width of the tape is presumably at least one factor. That is, the relatively wide width of a tape, as compared to the width of an individual fiber or tow, prevents the tape from being disposed in the desired configuration of the complex shape. Thus, Lichtenwalner is directed to the heating of narrow members.

Krause, on the other hand, describes a laser diode array as an alternative to conventional laser bonding devices that require technical measures for distributing the laser light uniformly

over a wide joint. Krause is directed to the bonding of metal layers in which such "bonding of metal layers must be performed without local melting of the surfaces of the two material surfaces to be joined. This imposes extreme demands on the homogeneity of the power density distribution at the joint." Col. 2, lines 29 to 33. Krause explains that "[i]n CO_2 lasers, homogenization is produced by beam-forming optics and/or vibrating mirrors. . . . If metal plates more than 1 meter wide are to be joined by bonding, a considerable technical and equipment cost is also required that entails correspondingly high costs to achieve homogenization of the power density distribution at the joining point of the two surfaces." Col. 2, lines 33 to 42. Thus, the requirement for distribution of laser light over a wide joint, as recognized by Krause, is not applicable to Lichtenwalner.

Further, Lichtenwalner does not describe any requirement for such uniformity in the distribution of laser light, as recognized by Krause. Indeed, while Krause states that metal layers must be bonded without local melting, Lichtenwalner specifically identifies the heated composite material as defining a "melt region" and a "polymer melt pool." *See* Fig. 1. While the temperature of the composite material may be important for placement according to the process described by Lichtenwalner, there is no teaching of any particular requirement for uniformity in energy distribution or heating, only that an appropriate temperature is achieved at the nip point. Lichtenwalner does not describe any particular temperature threshold to which the fiber or polymer materials are sensitive and which would require careful uniformity in energy distribution. Thus, Lichtenwalner does not describe the requirement for the local control of temperature in composite manufacturing that required uniform distribution of light in the metal bonding of Krause.

Thus, Applicant submits that no motivation exists for the combination of Krause and Lichtenwalner. The Examiner has asserted that Krause discloses motivations of long lifetime, low maintenance costs, and improved heating efficiencies. While such advantages may apply to the use of a laser diode array in place of a laser used in the conventional metal bonding systems described by Krause, such advantages do not necessarily apply to the use of laser diode array in the process described by Lichtenwalner. Indeed, some or all of these advantages are likely derived as a result of the requirement for uniformity and distribution of laser light in

conventional metal bonding systems, as described above. Lichtenwalner does not describe such requirements, as set forth above, and therefore it is unclear whether any of the advantages that the Examiner suggests could even apply to a laser diode array employed in a process such as that of Lichtenwalner. Further, neither Lichtenwalner nor Krause address whether a laser diode array would meet the technical requirements of the process described by Lichtenwalner for heating the fibers.

Thus, Applicant respectfully submits that no motivation existed for the combination of Lichtenwalner and Krause. Accordingly, Claim 1 is patentable over Lichtenwalner and Krause. Claims 2-4 and 6-11 are dependent on Claim 1 and therefore patentable over Lichtenwalner and Krause for the same reasons.

Further, as discussed during the telephone interview, several of the dependent claims provide additional bases of patentability over Lichtenwalner and Krause, separately or in combination. In particular, Claim 2 recites that "the laser diode array is configured to irradiate a plurality of irradiation zones such that each zone can be irradiated independently of the other irradiation zones." Claim 3, which is dependent on Claim 2, recites that "at least one of the irradiation zones defines an area on the fiber tape and at least one of the irradiation zones defines an area on the workpiece." Therefore, Claim 3 requires the laser diode array is configured to independently irradiate at least one irradiation zone on the fiber tape and at least one irradiation zone on the workpiece. As agreed to during the telephone interview, neither reference teaches or suggests a laser diode array configured to irradiate a zone on the fiber tape independently from a zone on the workpiece, as claimed. Figures 2 and 3 of Krause show laser diode bars **14** used as a single laser diode system **25** that can achieve a fully homogeneous power density distribution with high power laser radiation **10**. The radiation **10** is transmitted through cylindrical microlenses **16**, through a prism **17**, and then through a cylindrical lens **18** "to form a rectangular beam cross section **22**." Rectangular beam cross section **22** represents a single area or zone, the power of which is determined by the combination of the radiation from the laser diode bars **14**. Similarly, Figure 7 illustrates three laser diode systems **25** configured to transmit radiation through a cylindrical lens **18**. The laser radiation **10** "is fed to a cylindrical lens **18** that is common to them and is made in bar form to produce a single common rectangular beam cross

section 22." Col. 9, lines 26 to 40. There is no indication that either of the systems are configured to produce more than one independent zone of radiation, as set forth in Claim 2. In fact, Krause teaches the use of lenses for combining all of the radiation from the laser diodes in a "fully homogenous power density distribution." Col. 7, lines 15 to 19; col. 7, lines 47 to 48. Similarly, Figure 1 of Lichtenwalner illustrates a single beam of focused heat energy. Thus, neither of the references describes a device for irradiating a plurality of irradiation zones independently. Further, regarding Claim 3, there is no teaching in Lichtenwalner that the single beam of focused heat energy illustrated in Figure 1 is capable of independently irradiating zones on the fiber tape and the workpiece.

Similarly, Claim 9 recites that "the temperature sensor is configured to measure the temperature of at least one sensing zone and the controller is capable of automatically controlling the laser diode array to independently irradiate a plurality of irradiation zones, wherein each of the sensing zones and the irradiation zones defines an area selected from the group consisting of an area on one of the fiber tapes and an area on the workpiece." As noted above, Krause does not indicate that zones are independently irradiated.

Claim 4 recites that the inspection system includes "a camera for receiving images of the fiber tape after the fiber tape has passed through the compaction region." The Examiner has asserted that Lichtenwalner "discloses a focused infrared camera [that] monitors an image of the fiber tape at the point of bonding, i.e., past the compaction region (see page 687 and 688, especially section 2)." As noted by the Examiner during the telephone interview, Lichtenwalner refers to a focused infrared camera. However, Applicant finds no teaching in Lichtenwalner that the infrared temperature sensor monitors a point past the compaction region. In fact, Lichtenwalner cites the importance of the temperature at the nip point. *See* Page 688, section 2.

Applicant further submits that Kitson and Albers also fail to disclose a composite material collation machine having a laser diode array for heating at least one fiber tape as set forth in Claim 1 and the dependent claims.

For the foregoing reasons, Applicant submits that Claims 1-11 are in condition for allowance and solicits the Examiner's concurrence. Further, Applicant submits that the above

comments accurately describe the substance of the April 6, 2004 telephonic interview per Manual of Patent Examining Procedure (MPEP) § 713.04.

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CONCLUSIONS

It is not believed that extensions of time or fees for net addition of claims are required, beyond those that may otherwise be provided for in documents accompanying this paper. However, in the event that additional extensions of time are necessary to allow consideration of this paper, such extensions are hereby petitioned under 37 CFR § 1.136(a), and any fee required therefore (including fees for net addition of claims) is hereby authorized to be charged to Deposit Account No. 16-0605.

Respectfully submitted,

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